PROC. BIOL. SOC. WASH.
93(2), 1980, pp. 490–514

THE GENUS *GRANDIFOXUS* (CRUSTACEA: AMPHIPODA: PHOXOCEPHALIDAE) FROM THE NORTHEASTERN PACIFIC OCEAN

J. Laurens Barnard

Abstract.—*Grandifoxus* now comprises 3 valid species, as follows: *G. grandis* (Stimpson) (=*milleri* Thorsteinson); *G. longirostris* (Gurjanova), and an unnamed species R; the latter is assumed to be *Pontharpinia robusta* Gurjanova, an obscure species. Taxa called species J and species 51 are also described but are believed to be seniles; their validity remains to be demonstrated. The genus is fossorial, lives in very shallow water, has some of the largest species in the family and ranges between Bering Sea and Monterey Bay California, and possibly into the Japan Sea.

The phoxocephalid genus *Grandifoxus* was recently carved out of the polytypic *Paraphoxus* by J. L. Barnard (1979). The species comprising this genus are now presented. In the Americas the generic taxonomy of this family is very subtle, so that *Grandifoxus* differs from *Metharpinia,* the southern ancestral genus, in characters of small magnitude requiring meticulous observation. Evolutionary flow appears to proceed from Magellan South America to the North Pacific Ocean and Bering Sea. Usage of "America" herein includes the entire Western Hemisphere.

The diagnoses of *Grandifoxus* and its cohorts were given by J. L. Barnard (1979). *Grandifoxus* appears to have descended from *Metharpinia* through loss of basally articulate spines on the apical margins of the rami on uropods 1–2, and the development in adults of 2 modifications: the presence of more than 2 facial setae on article 3 of antenna 2 and in a majority of individuals the development of a bulge, tooth, or cusp on article 1 of antenna 2 (a condition known as "ensiform").

Like *Metharpinia,* the telson of adults in *Grandifoxus* bears supernumerary dorsolateral spines (uncommon in Phoxocephalidae), epimeron 3 has more than 3 setae and its posterior margin does not grossly depart from a "normal" condition (see below), the rostrum is constricted, article 2 of antenna 1 has widespread ventral setae, the mandibular molar has 4 or more spines, the right lacinia mobilis is present, article 4 of antenna 2 has more than one row of facial spines and the genus otherwise belongs in the birubiinparharpiniin group of phoxocephalid genera as defined by Barnard and Drummond (1978).

The kind of characters now considered important in Phoxocephalidae

makes the identification of genera difficult and tedious. Much practice with obvious adults (females with brood plates, males with penes) must be undertaken within a faunistic region before juveniles of certain species can be identified; and occasionally juveniles seem to be unidentifiable or at best their identification is unreliable. *Grandifoxus* occurs from California northward to Alaska and east Siberia, but much of the seabottom off Canada and Alaska is unexplored, hence reliable keys to juveniles are yet impossible because undiscovered species presumably await description. This treatment is therefore simply exploratory.

Unfortunately, *Pontharpinia robusta* Gurjanova (1938) and *Pontharpinia robusta lindbergi* Gurjanova (1953) which probably belong to *Grandifoxus* need to be redescribed from original material before they can be fitted among the taxa here described. Perhaps their names should be applied to taxa here designated only by letters or numbers.

In Australia the scores of species in the birubiin-parharpiniin group were found by Barnard and Drummond (1978) to be strongly divisible into genera but in the Americas these generic distinctions are poorly developed. This led J. L. Barnard (1960) to put all such species into *Paraphoxus* but that was before the Australian species had been described and clarified. Without the Australian taxonomic basis one doubts that the American species would be considered to be worth dividing generically at this time. The present division may actually fall apart as more species are found which link the weakly distinguished groups. Nevertheless, the establishment of these genera has forged a better understanding on the origin and deployment of their species and also focuses more intently on the need for extreme care in identification of phoxocephalids.

The normal kind of epimeron 3 mentioned above is defined by Barnard and Drummond (1978:24, fig. 83, parts 4–15) as lacking any gross posterior ornamentation, and bearing more than 3 setae (can be in various places). In *Grandifoxus* epimeron 3 has a straight or weakly concave, convex or sinuous posterior margin with 3 or more setae near the ventral end of the margin and usually has one or more setae on or near the horizontal ventral margin of the epimeron. Adults also have significant posterior setae on epimeron 2, a helpful signal to identification but not a character limited to this genus.

In identifying American phoxocephalids my usual procedure is to examine characters in the following sequence:

1. Article 2 of pereopod 5 broad or narrow, tapering or even (broad and even in *Grandifoxus*).

2. Rapid examination for grossly unusual characters such as giant spines; elongate peduncle of uropod 3; shortened rami of uropods 1–3; giant teeth on urosome or pereopods; large gnathopods; unusual coxae.

3. Head shape (from dorsal view rostrum unconstricted in *Grandifoxus*).

4. Article 2 of antenna 1 length and ventral setation: most American taxa (including *Grandifoxus*) with ordinary length and wide ventral setation; alternative in *Eobrolgus* is short with setation shifted towards or onto apex.

5. Spination on article 4 of antenna 2: usually with 2 or more well developed spine rows; alternative in true *Paraphoxus* is one row or one well developed row with second row of sparse and thin spines or setae.

6. Setation of article 3 on antenna 2: most genera with 2 tiny setae almost impossible to see except by dissection and mounting of antenna 2 on slide for observation by compound microscopy. *Grandifoxus* bears 3 or more long setae in adults.

7. Presence or absence of ensiformity on article 1 of antenna 2 (bulge, tooth or cusp common in American taxa, rare in Australian or southern taxa except in other subfamilies such as Harpiniinae); absent in *Metharpinia*, present in full adults of *Grandifoxus*.

8. Presence or absence of supernumerary armaments on telson; ordinary telson has only apical spines, usually fewer than 4 on each lobe, plus pair of tiny lateral setae almost too small to see except with high powered compound microscopy. *Grandifoxus* has supernumerary subapical spines and setae on each side of telson.

9. Presence or absence of erect and flexible spines on dorsal margins of rami on uropods 1–2 near but not precisely at apices. A majority of phoxocephalids bear apical spines, usually partly to strongly immersed in apex to form nails like human fingernails. Supernumerary apical nails or apical spines are prevalent in harpiniin and pontharpiniin phoxocephalids but in birubiin-parharpiniin taxa these are rare and very useful as taxonomic markers, as in *Metharpinia*. The presence of only one accessory apical nail (erect) on just one ramus of uropods 1–2 is sufficient to mark *Metharpinia*. Therefore, specimens with broken uropods are poor material for practicing identifications until one obtains experience on perfect specimens.

10. Presence or absence of displaced apical spine on peduncle of uropod 1; if present this spine is attached to the apex and not to the lateral margin of the peduncle. In Australia the presence or absence of this spine has generic significance but in the Americas the spine exists in vestigial form on certain intermediary species and therefore has not developed its generic significance; and it is not perfectly correlated with other characters of generic value. However, it is a very useful specific character-alternative in most American species.

Many other less frequently occurring character anomalies must be checked within each genus until familiarity is attained with the 10 external characters listed above sufficient to guide the identifier close to specific decision.

11. Most importantly is the need to dissect the mandibles, mount them separately in refractive medium (glycerin is adequate) on 2 different slides,

adding sand grains around the mandibles to support the cover slips and prevent crushing while allowing the mandibles to be rotated and inspected. The characters to be checked are: (a), number of incisorial teeth, usually 3 but rarely otherwise; (b), form of right lacinia mobilis, usually bifid and distinct from raker spines but rarely so similar to spines so as to be indistinguishable; shape often strongly congruent and consistent within growth stages and races of certain species but in other species varying in degree from juvenile to adult stages and widely variable among members of a deme or between geographic races; (c), number of spines on molars, in Brolginae 3 or fewer, in parharpiniin-birubiniin taxa 4 or more; molar must be rotated and examined carefully under high power of compound microscope; (d), shape and setation of palp; and (e), size of mandibular hump to which palp is attached. Ultimately, within a narrow fauna, identification of species need not involve mandibles except in rare cases.

12. Maxillipeds dissected and mounted on slide to check: (a), number of peg-like apical spines on inner plate (consistent in growth stages generally) and (b), degree of fusion of apical spine on palp article 4. Ultimately, most external characters suffice for identification although one species of *Rhepoxynius* is distinguishable mainly on maxillipedal spine counts.

Until experience is gained and the identifier is automatically and rapidly inspecting numerous other characters, one should make a point of grossly examining coxae, gnathopods, pereopods, and epimera for conformity to specimens already identified, taking into account size and remoteness of locality to explain minor proportional and setational differences on loci not already known to have critical generic or specific characteristics. To see the presence or absence of setae on the side of urosomite 1 and the face of uropod 1 at the base is often a tedious chore requiring careful dissection and mounting of parts on slides for examination under high power microscopy. In several species outside *Grandifoxus* these have importance so that further work on *Grandifoxus* may require checking such loci.

Trends in amphipod taxonomy lately have been mixed, one group of splitters carving out species, even genera, on the basis of patterns in armaments (setae and spines), and one group of lumpers synonymizing genera, even species, by showing wide variability in armanent patterns. Owing to the paucity of exploration in phoxocephalids we remain in the splitting stage. This requires close examination of minor characters and description of numerous morphs.

Corrections to previous work.—In J. L. Barnard (1979) transcription errors occur: on p. 368, under *Metharpinia,* last line of first paragraph in diagnosis, apical nail should be noted as "strongly distinct"; in line 2 of paragraph 3 the first word "out" should be eliminated so as to indicate that uropod 1 has a displaced apicomedial spine.

On p. 376, line 16 and p. 377, line 31, the phrase "pereopods 1–2" should read "pereopods 3–4."

On p. 377, line 5, remove the second "2" so as to indicate that article 5 is elongate only on gnathopod 1.

The illustrations of J. L. Barnard (1960) should be used for general identification as the illustrations presented herein are only supplemental.

Grandifoxus J. L. Barnard

Grandifoxus J. L. Barnard, 1979:374 (*Phoxus grandis* Stimpson, 1856, =*Pontharpinia milleri* Thorsteinson, 1941).

Diagnosis.—See J. L. Barnard (1979).

Remarks.—As in so many phoxocephalids there appears to be a great deal of variability in specimens of this genus, especially museum collections which usually are composed of the largest or oldest or most senile specimens or are composed of material from the shallowest of waters where surf is heaviest or in ponded waters of inlets where environmental factors are variable and harsh. I have linked these specimens all together into 2 main taxa, the *longirostris* group or assumed plesiomorph in which the displaced spine on uropod 1 is well developed and uropod 3 has a series of paired spines, and the *grandis* group in which the displaced spine is vestigial or absent and spines on uropod 3 are in triads. The latter group has 2 weakly divided species based on presence or absence of a spine on the inner ramus of uropod 2 and the degree of setation on epimeron 3. The latter character is especially difficult to use because setation is so variable in taxa such as phoxocephalids which have hugely variable size ranges and degrees of maturation. However, in a genus yet to be presented, *Foxiphalus*, species based on setation patterns of epimeron 3 have been detected and in *Birubius*, the diverse Australian genus, Barnard and Drummond (1978) concluded they could identify almost any adult in the genus on epimeron 3 setation pattern alone.

Names for two difficult specimens, one related to *grandis*, the other to species R, are reserved for better collections; in each case they are characterized by rhombic spines on uropods 1–2.

Within the Californian phoxocephalid fauna *Grandifoxus grandis* (=*milleri*) is rather easy to detect because of the sharply cuspidate coxae but in more northerly waters this ease of detection deteriorates. Coxal protrusions are well developed but blunt in *G.* species R, weak in *G. longirostris* and almost absent in its Alaskan form (near Kyska) and almost indetectible in *Grandifoxus* sp. 51.

The ensiform condition that distinguishes so many American genera from Australian genera is very poorly developed in many demes of *G. grandis*,

especially in those in which sexual maturity is reached at small body size, especially in the southern part of its range. On a global basis this could be confusing if one were attempting to identify "unknowns" in a teacher's practice session. When faunistic keys are devised for the Californian and Alaskan provinces the ensiformity of antenna 2 should be deemphasized.

Pontarpinia [sic] *nasuta* Gurjanova (1936) remains enigmatic; it is close to *Grandifoxus* but has 2 strong spines on the mandibular molar and therefore is assumed to be in a distinct genus.

Key to the species of *Grandifoxus*

1. Medial apex of peduncle on uropod 1 with large displaced spine, urosomite 1 lacking row of lateral facial setae ..... *G. longirostris*
– Medial apex of peduncle on uropod 1 with ordinary to small spine at corner, not displaced, urosomite 1 with row of lateral facial setae 2
2. Inner ramus of uropod 2 with marginal spine(s) 3
– Inner ramus of uropod 2 without marginal spines 4
3. Spines on rami of uropods 1–2 ordinary, setae on coxa 1 widely spread ..... *G. grandis* (=*milleri*)
– Spines on rami of uropods 1–2 short, especially on inner rami, setae on coxa 1 narrowly spread ..... *Grandifoxus* sp. J
4. Lateral spines on article 1 of outer ramus on uropod 3 in triads, spines on rami of uropods 1–2 of ordinary size .... *Grandifoxus* sp. R
– Lateral spines on article 1 of outer ramus on uropod 3 in pairs, spines on rami of uropods 1–2 very short ..... *Grandifoxus* sp. 51

Grandifoxus grandis (Stimpson), new synonymy
Fig. 1, upper right

Phoxus grandis Stimpson, 1856:90; 1857:81–82.
Pontharpinia milleri Thorsteinson, 1941:82, pl. 5, figs. 52–62 (new synonym).
Paraphoxus milleri.—J. L. Barnard, 1958:147; 1960:266–269, pl. 40.

Nomenclature.—Barnard (1979) made this the type-species of *Grandifoxus*. The odd coxae are quite sufficient within the faunal framework to pick out Stimpson's species and to make *milleri* its junior synonym. This disposes of a long pending case of obscurity for *grandis* but, despite a 50-year rule in the ICZN, little inconvenience should ensue by sinking *milleri* because the name has seldom been used; it is moderately well known to several Californian taxonomists identifying materials for unpublished Bureau of Land Management surveys and local pollution studies. I understand in general their convenience would be suited by deciding what *grandis* represents and honoring the name. For years, on size alone, I entertained an

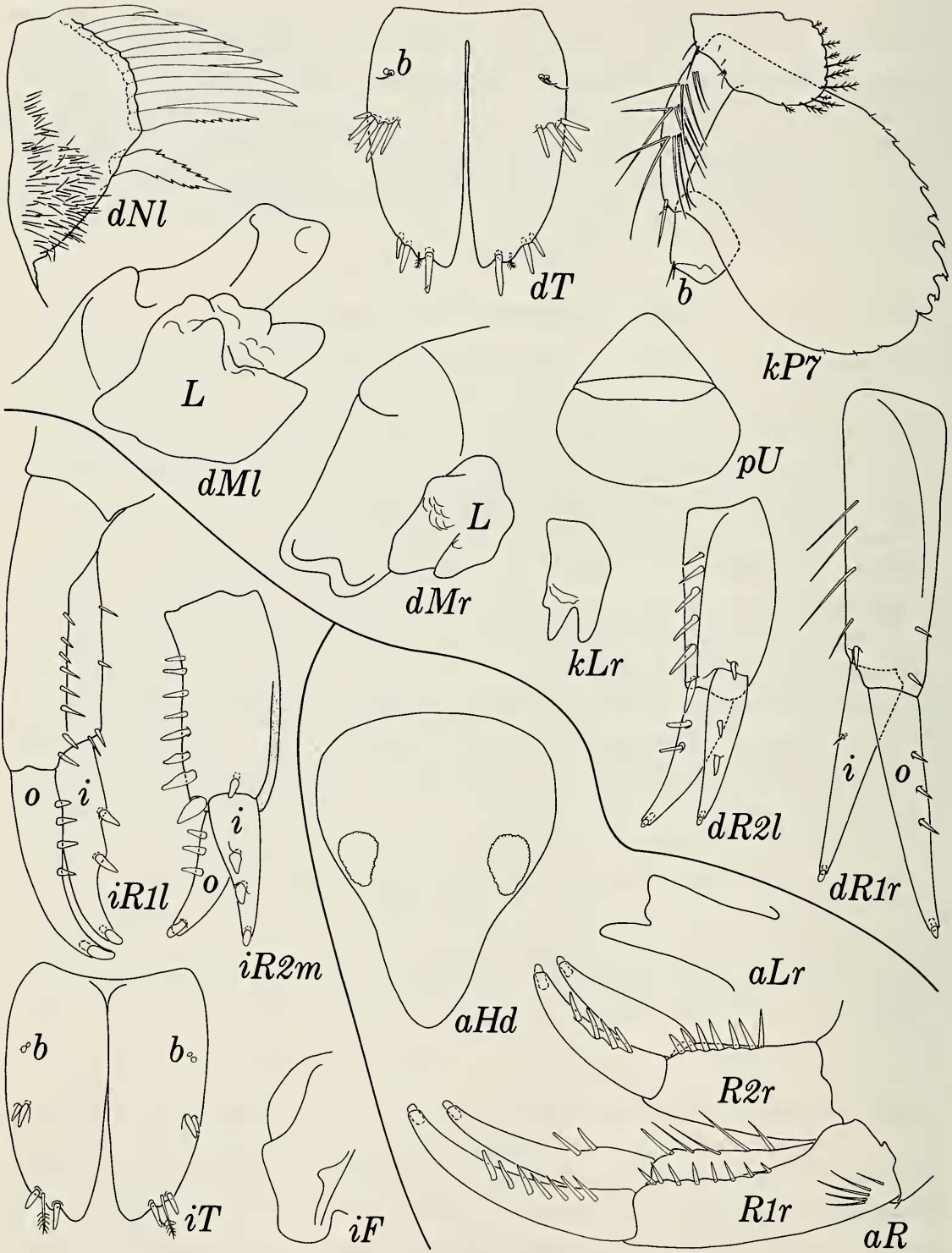

Fig. 1. UPPER RIGHT, *Grandifoxus grandis*: **d** = female "d," **k** = male "k," **p** = female "p." LOWER LEFT, *Grandifoxus* sp. J: **i** = female "i." Lower right, *Grandifoxus* sp. 51, a = female "a."

Capital letters refer to parts; lower case letters to left of capitals refer to specimens cited in "Voucher Material" for each taxon; lower case letters to right of capitals refer to adjectives cited below: **C**, coxa; **E**, epimera; **F**, epistome, lateral; **G**, gnathopod; **H**, head; **L**, lacinia mobilis; **M**, mandible, **N**, molar; **P**, pereopod; **R**, uropod; **T**, telson; **U**, upper lip; **W**, pleon. **b**, broken; **d**, dorsal; **i**, inner; **l**, left; **m**, medial; **o**, outer; **r**, right; **s**, setae.

idea that *Foxiphalus major* (J. L. Barnard, 1960) was a junior synonym of *Phoxus grandis* but large specimens of *milleri* bearing the appropriate coxae described by Stimpson have clinched the argument.

Description of female "d."—Head about 20+ percent of total body length, greatest width about 75% of length, rostrum constricted, narrow, short, reaching middle of article 2 on antenna 1. Eyes small to medium, largely occluded with pigment, ommatidia ordinary. Article 1 of peduncle on antenna 1 about 1.2 times as long as wide, about twice as wide as article 2, ventral margin with about 17 setules, weakly produced dorsal apex with 2 setules, article 2 about 0.7 times as long as article 1, with ventral doubled over crescent of 20 widely spread setae and apicolateral crescent of 8 setae, primary flagellum with 12 articles, about 0.8 times as long as peduncle, bearing one short aesthetasc each on articles 6–11, accessory flagellum with 11 articles. Article 3 of antenna 2 with 2 rows of 6 and 6 setae, distal row horizontal, proximal row vertical, article 1 not ensiform (exception to generic plan). Spine formula of article 4 on antenna 2 = 13-9, dorsal margin with 4 notches bearing 3 setae and one spine each, ventral margin with 15 groups of 1–6 long-to-short setae, one ventrodistal long spine, article 5 apically stout, about 0.75 times as long as article 4, facial spine formula = 12, dorsal margin bearing 4 sets of 1–3 small setae, ventral margin with 10 sets of 2–4 long to short setae, ventrodistal group of many long setae, 2 long subdistal facial spines; flagellum about 0.8 times as long as or longer than articles 4–5 of peduncle combined, with 15 articles.

Mandibles with medium palpar hump, right incisor with 3 teeth, third highly distad, left incisor with 3 humps in 2 branches, right lacinia mobilis bifid, flabellate, distal branch longer than proximal, with facial humps, proximal branch with facial hump, left lacinia mobilis with 4 teeth plus 2 facial teeth, right and left rakers 10 each, molars composed of bulbous plaques, right molar with 9 primarily long spines plus one spine weakly disjunct, left molar with 10 primarily long spines plus one medium spine weakly disjunct, each molar with proximal scattered plume; palp article 1 short, article 2 with 3 short to medium inner apical setae and one other shorter inner seta, article 3 about as long as article 2, oblique apex with 11 spine-setae, basofacial formula = 3-4 or 2-4, groups opposite but skewed. Lower lip lacking cones. Inner plate of maxilla 1 ordinary, bearing one medium apical pluseta, one similar apicomedial seta, 2 apicolateral scarcely shorter setae, palp article 2 with 7 apical and medial marginal setae and 6 scarcely submarginal setae. Inner plate of maxilla 2 shorter than outer, outer broader than inner, outer with 4 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 4 apicofacial setae, 7 medial setae, outer plate with 10 medial spines, 4 apicolateral setae, no cusp, palp article 1 without apicolateral setae, article 2 with 3 groups of 6 apicolateral setae, medial margin of article 2 strongly setose, article 3 with many strewn

facial setae, triad of lateral setae, nail of article 4 short, bifid or with scale, mostly fused, with 2 accessory setules.

Coxa 1 scarcely expanded apically, anterior margin weakly convex, main ventral setae of coxa 1–4 = 17-10-13-13 (+13 posterior setae), widely spread, posteriormost seta of coxae 1–3 shortest, coxae 1–3 with sharp posteroventral cusp, anterior and posterior margins of coxa 4 parallel, posterior margin straight, posterodorsal corner sharp, posterodorsal margin short, concave, width-length ratio of coxa = 2:3. Gnathopods weakly trichophoxin, anterior margins of hands strongly setose, width ratios on articles 5–6 of gnathopods 1–2 = 28:28 and 29:29, length ratios = 65:47 and 67:44, palmar humps very small, palms weakly oblique, article 5 of gnathopod 1 elongate, ovate, posterior margin flat, long, article 5 of gnathopod 2 elongate, ovate, posterior margin flat, short.

Pereopod 4 stouter than pereopod 3 especially on articles 4–5, facial setae formula on article 4 = 8 and 6, tight, confined to and parallel to apex, on article 5 = 10 and 10, main spine of article 5 extending to M. 80 on article 6, article 5 with no proximoposterior spines and naked proximally, spine formula of article 6 = 13 + 12 and 12 + 11 and no middistal seta or spine, some spines especially long, acclivity on inner margin of dactyls of pereopods 3–4 distad, sharp, produced as tooth, emergent setule short, midfacial pluseta ordinary. Coxae 5–7 posteroventral seta formula = 14-13(none proximoventral)-11. Articles 4–5 of pereopods 5–6 broad, facial spine rows dense, facial ridge formula of article 2 on pereopods 5–7 = 0-1-1, dactyls short, width ratios of articles 2,4,5,6 of pereopod 5 = 58:70:62:23, of pereopod 6 = 105:90:56:20, of pereopod 7 = 90:27:29:12, length ratios of pereopod 5 = 108:52:52:38, of pereopod 6 = 115:66:62:75, of pereopod 7 = 101:25:36:37, article 2 of pereopod 7 almost reaching apex of article 4, posterior margin with 9–10 serrations, several large, ventralmost rounded and bounded by seta, medial apex of article 6 not combed, bearing 1–2 weak digital processes, moderately spinose.

Posteroventral corner of epimeron 1 weakly protuberant, posterior margin weakly convex, serrate, setose (11), corner without setule, anteroventral margin setose, posteroventral face with row of 4–6 long setae, several other facial setae below ridge. Posteroventral corner of epimeron 2 weakly protuberant, without setule sinus, posterior margin straight, serrate, setose (20), anteroventral setae = 14, facial setae = 11–12, widely strewn, several in vertical pairs. Posteroventral corner of epimeron 3 rounded, weakly protuberant, without setule sinus, posterior margin straight or weakly convex, weakly serrate, with one setule notch and 5–7 posteroventral setae tightly confined, ventral margin with 11 setae widely spread, several in vertical pairs.

Urosomite 1 with 6 lateral setae far anteriad plus ventral brush, articu-

lation line almost complete, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed apical nails, none with accessory nails, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines, inner with 2 dorsomedial spines, peduncle of uropod 1 with 2 basofacial setae and 2 small apicolateral spines, medially with 5 thin marginal spines, apicalmost a very small spine plus slightly larger weakly displaced spine, peduncle of uropod 2 with 6 widely spread dorsal spines, distalmost not enlarged, proximalmost small, medially with one small apical spine, apicolateral corner of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 5 basoventral and 8 proximoventral spines, dorsally with 2 lateral spines, one medial spine and setule, rami submasculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins with many setae and 4 setae respectively, article 2 of outer ramus very short, 0.05, bearing 2 medium setae, medial margin of article 1 widely setose, lateral margin with 5 acclivities, spine formula = 2-3-3-3-3-2, spines short, setal formula = 0.

Telson especially long, length-width ratio = 19:14, almost fully cleft, each apex of medium width, weakly pointed, then beveled, lateral acclivities deep, narrow, with 2 lateral and one medial spines separated by setules, armament widely spread, plus spray of 4–5 dorsolateral spines, lateral setules somewhat basad, weakly diverse, of medium size.

Remarks on female "d."—This specimen was selected for redescription because it was in a sample of material in Smithsonian collections originally identified by Thorsteinson, the describer of the species. However, the following items have been taken from female "p" to confirm broken or poorly preserved features on the specimen: maxillipeds and flagella of antennae. Article 3 of antenna 1 is unusual in bearing a crescent of 5+ setae. Despite Thorsteinson's original description and most other adult specimens of *grandis* (=*milleri*), antenna 2 is not ensiform on female "d." The epistome resembles that shown for "jeweled *milleri*" (=*Grandifoxus* sp. J).

Female "p."—Setal armament of epimeron 1 anteroventral = 19 in bundles, facial = 6 plus posteroventral oblique row of 6 (or in pairs from margin onto face), posterior = 18; epimeron 2, anterior = 10, facial = 14 strewn, posterior = 27; epimeron 3, anterior = 19, ventral = 11 widely spread and several in pairs and triads set vertically, posterior = 7.

Male "k" young.—Poorly developed as male phoxocephalid, eyes scarcely enlarged, pubescence absent from antennae. Article 2 of antenna 1 with 22 ventral setae in reversed crescent, apex with 8 setae, article 3 with 5 medial setae, primary flagellum with 14 articles, accessory with 11, primary flagellum proliferating basally, aesthetascs moderately well developed on articles 6–13.

Article 3 of antenna 2 with 5 + 5 setae on face, spines on article 4 = 13–

10, on 5 = 11, flagellum short but proliferate; article 4 of peduncle dorsally with 3 notches, spines = 3, setae = 3+ each per notch.

Left mandible like female, right lacinia mobilis bifid, branches equal (illustrated). Inner plate of maxilliped with 2–3 apical stout spines (third more slender than others), outer plate with 9 medial spines, no cusp, 3 apicolateral setae, lateral setae on palp article 1 = 0, article 2 = 3 apical, 1 lateral, article 3 = 12 plus strewn facials and 4 lateral, article 4 = nail short, bifid, almost fused, accessory setules = 2.

Epimera slightly broadened, setae of epimeron 1 anteroventral = 14, posteroventral face = 2 slightly oblique rows of 3 and 2, 3 other facials, ventral = 1, posterior = 13; epimeron 2 facial = 13 broadly strewn, posterior = 16; epimeron 3, ventral = 8 widely spread, four of these in 2 vertical pairs, posterior = 8 on about half of margin (lower).

Urosomite 1 with 4 thick facial setae. Uropod 1 with 2 basofacial setae, apicolaterally with 3 widely spread spines, medially with smallest spine being displaced, outer ramus with 3 spines, inner with 1. Uropod 2 peduncle with 5 lateral spines, outer ramus with 3, inner with 2. Uropod 3 outer ramus article 1 lateral spines = 2-2-2-2-2-2, short setae = 0-0-0-0-0-3.

Telson with one lobe normal to female, other lobe with 1 apical spine, then setule, next 2 spines (towards lateral edge) widespread, fourth fully lateral; dorsal surface with only 2 spines; all spines shorter than in female, denticle rows rudimentary.

Voucher material.—Female "d" 10.00 mm, USNM 105464, Pt. Roberts, Washington, USA, coll. E. D. Thorsteinson, 29 January 1931; female "p" 10.45 mm, North Sandspit (?British Columbia), +6.0′, sand burrowing amphipods, Stubbs, 10 June 1946; young male "k" 8.66 mm, *Albatross* H. 5172, San Francisco Bay, California, USA.

Other material.—Pacific Grove, California, USA, July, 1895, G. O. Snyder (1); Humboldt Bay, California, USA, surface sand, 2 January 1931, G. E. MacGinitie (1); Puget Sound, Washington, USA (USNM Acc. 161068) (10) and specimens from following *Albatross* stations, apparently all in San Francisco Bay, California: H. 4987, 4989, 5083, 5106, 5107, 5109, 5111, 5146, 5167, 5168, 5295 [no biological samples are said to have been taken at H stations but regular station numbers are out of context with vial labels, = China Seas, etc.].

Distribution.—Pacific Grove, California to Strait of Georgia, British Columbia, intertidal and shallow water.

Grandifoxus species J
Fig. 1, lower left

Nomenclature.—Known as "jeweled *milleri*" because of the rhombic form of spines on uropods 1–2, this unique specimen from Pacific Grove,

California, is suspected of being a senile *grandis* (=*milleri*): it has male penial processes and no brood plates but otherwise has no secondary sexual characters of males. This specimen also differs from *G. milleri* in the narrow spread of setae on coxae 1–2, the lack of facial setae on urosomite 1 and the presence of pairs (not triads) of spines on article 1 of the outer ramus on uropod 3.

Description of senile male "i."—Head about 17 percent of total body length, greatest width about 75 percent of length, rostrum constricted, narrow, short, not reaching apex of article 2 on antenna 1. Eyes medium to large, clear of pigment (old material), ommatidia ordinary. Article 1 of peduncle on antenna 1 about 1.5 times as long as wide, about twice as wide as article 2, ventral margin with 2 setules, weakly produced dorsal apex with 2 setules, article 2 about 0.8 times as long as article 1, with ventral redoubled crescent of 16 setae, primary flagellum with 15 articles, about 0.78 times as long as peduncle, bearing several short aesthetascs (formula unavailable owing to breakage), accessory flagellum [unknown, broken]. Article 3 of antenna 2 with 2 rows of 2 and 2 setae, distal row horizontal, proximal row vertical, article 1 not ensiform, spine formula on article 4 = 11-8, mixed long and short, dorsal margin with 3 notches bearing 1–3 setae and one spine each, ventral margin with 9 groups of 1–4 long to medium setae, one ventrodistal long spine, article 5 about 0.75 times as long as article 4, facial spine formula = 2-5, mixed long and short, dorsal margin bearing 6 sets of short setae, ventral margin with 11 sets of 1–3 long to short setae, 2 ventrodistal long to medium spines set facially, flagellum about 1.1 times as long as articles 4–5 of peduncle combined, with 17 articles.

Mandibles with medium palpar hump, right incisor with 3 teeth, third moderately distad, left incisor with 3 humps in 2 branches, right lacinia mobilis bifid or trifid, flabellate, distal branch little shorter than proximal, latter with facial hump, left lacinia mobilis with 4 teeth plus several facial teeth, middle teeth weakly shortened, right rakers 9, left rakers 10, molars composed of bulbous plaques, right molar with 7 primarily long spines plus one spine weakly disjunct, left molar with 8 primarily long spines plus one spine weakly disjunct, each molar with plume, palp article 1 short, article 2 with 2 short inner apical setae and 1–2 other shorter inner setae, article 3 about as long as article 2, oblique apex with 9–11 spine-setae, basofacial formula = 1-1-2 (latter opposite) or 2-2-4. Inner lobes of lower lip each with one tiny cone. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral much shorter setae, palp article 2 with one apical spine, one apicolateral and 5 medial and 3 submarginal spine-setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 5 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 3 apicofacial setae, 7 medial setae, outer plate with 10 medial spines, 6 api-

colateral setae, no cusp, palp article 1 with no apicolateral seta, article 2 with 2 groups of 3 apicolateral setae, medial margin of article 2 strongly setose, article 3 with 13 strewn facial setae, 5 lateral setae in one group, nail of article 4 short, almost fused and weakly sleeved, with 2 accessory setules.

Coxa 1 scarcely expanded apically, anterior margin straight, main ventral setae of coxa 1–4 = 17-13-12-8 (and 17 posterior setae), narrowly spread, posteriormost seta of coxae 1–3 shortest, coxae 1–3 with weak blunt posteroventral cusp, anterior and posterior margins of coxa 4 parallel, posterior margin weakly convex, posterodorsal corner rounded, posterodorsal margin short, almost straight, width-length ratio of coxa 4 = 2:3. Gnathopods with wrists very elongate, hands weakly trichophoxin and anterior margins strongly setose, width ratios on articles 5–6 of gnathopods 1–2 = 20:27 and 21:26, length ratios = 65:45 and 64:43, palmar humps ordinary, small, palms transverse, article 5 of gnathopod 1 elongate, ovate, posterior margin flat, long, article 5 of gnathopod 2 elongate, ovate, posterior margin rounded.

Pereopod 4 stouter than pereopod 3, especially on articles 4–5, facial setae formula on article 4 = 6 and 7 parallel to apex, on article 5 = 4 and 6, main spine of article 5 extending to M. 75 on article 6, article 5 with no proximoposterior spines and naked basally, spine formula of article 6 = 9 + 10 and 8 + 9 plus no middistal seta, some spines especially long, acclivity on inner margin of dactyls pereopods 3–4 distad, sharp, produced as tooth, emergent setule short, midfacial pluseta ordinary. Coxae 5–7 posteroventral seta formula = 14-11-10. Articles 4–5 of pereopods 5–6 broad, facial spine rows dense, facial ridge formulas of article 2 on pereopods 5–7 = 0-1-1, width ratios of articles 2,4,5,6 of pereopod 5 = 52:48:45:20, of pereopod 6 = 90:66:41:15, of pereopod 7 = 76:19:22:10, length ratios of pereopod 5 = 93:52:48:37, of pereopod 6 = 100:65:61:78, of pereopod 7 = 100:23:35:32, article 2 of pereopod 7 reaching middle of article 5!, posterior margin with 11–12 serrations, several large, ventralmost rounded and bounded by seta, medial apex of article 6 finely combed, bearing 1–2 digital processes, moderately spinose.

Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, serrate, setose (7), anteroventral margin with 11 short to medium setae, posteroventral face at posterior margin with 4 and 2 long setae set in 2 vertical groups or 4 in set and 4 others strewn. Posteroventral corner of epimeron 2 rounded-quadrate, posterior margin straight, serrate, setose (11), facial setae = 5–8 strewn, 2 pairs set vertically. Posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin weakly concave, then convex, with 2–3 setule notches, with 6 setae tightly confined to lower corner, ventral margin with 4–5 setae.

Urosomite 1 with lateral setule at base of uropod 1, articulation line almost complete, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with

articulate but tightly fixed apical nails, no accessory nails, outer ramus of uropod 1 with 4 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with 2 dorsomedial spines, spines of inner rami extremely rhombic, peduncle of uropod 1 with 2 basofacial setae and 8 lateral spines, medially with 3 small marginal, widely spread spines, apicalmost ordinary, plus tiny displaced spine, peduncle of uropod 2 with 8 dorsal spines, apicalmost thick and rhombic, basalmost small, medially with one large apical spine, apicolateral corners of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, 2 medial spines, rami masculine, inner extending to M. 110 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins strongly setose, article 2 of outer ramus short, 0.05, bearing 2 medium setae, medial margin of article 1 widely setose, lateral margin with 3 acclivities, spine formula = 2-2-2-0, setal formula = 0-0-0-2. Telson especially long, length-width ratio = 19:15, almost fully cleft, each apex of medium width to narrow, rounded-protuberant, lateral acclivities broad, weak, with short lateral and medial spines separated by longer setule, each lobe with pair of short dorsolateral spines, midlateral setules broken, position normal to *milleri*.

Material.—Senile male "i" 14.60 mm, Pacific Grove, California, USA, 1895 July, G. O. Snyder.

Grandifoxus longirostris (Gurjanova)
Fig. 2, lower

Pontharpinia longirostris Gurjanova, 1938:263–267, 385, fig. 7; 1951:385–387, fig. 235 (not *Paraphoxus milleri* of J. L. Barnard, 1960 and not *P. robusta* Gurjanova, 1938).

?*Pontharpinia robusta lindbergi* Gurjanova, 1953:224–225, figs. 7, 8.

Nomenclature.—J. L. Barnard (1960) thought *longirostris* to be a synonym of *milleri* (Thorsteinson) but specimens demonstrate the presence of a strong displaced spine on uropod 1 of *longirostris*. Modern rules and practice allow extraction of *longirostris* from its former homonymy with *Paraphoxus longirostris* Schellenberg, 1931; its senior synonym is not now congeneric.

Pontarpinia [*sic*] *robusta lindbergi* may be a snyonym of *longirostris* because the lateral spines on the outer ramus of uropod 3 are paired; uropod 1 of that species is, however, unknown, and final identification cannot be confirmed. The only specimens available are a juvenile identified by Gurjanova and given to Smithsonian Institution presumably in the 1930's and a giant female; many small clues suggest the two specimens are conspecific and truly represent *longirostris*.

Description of juvenile "h" (=juvenile or *longirostris* form).—Head

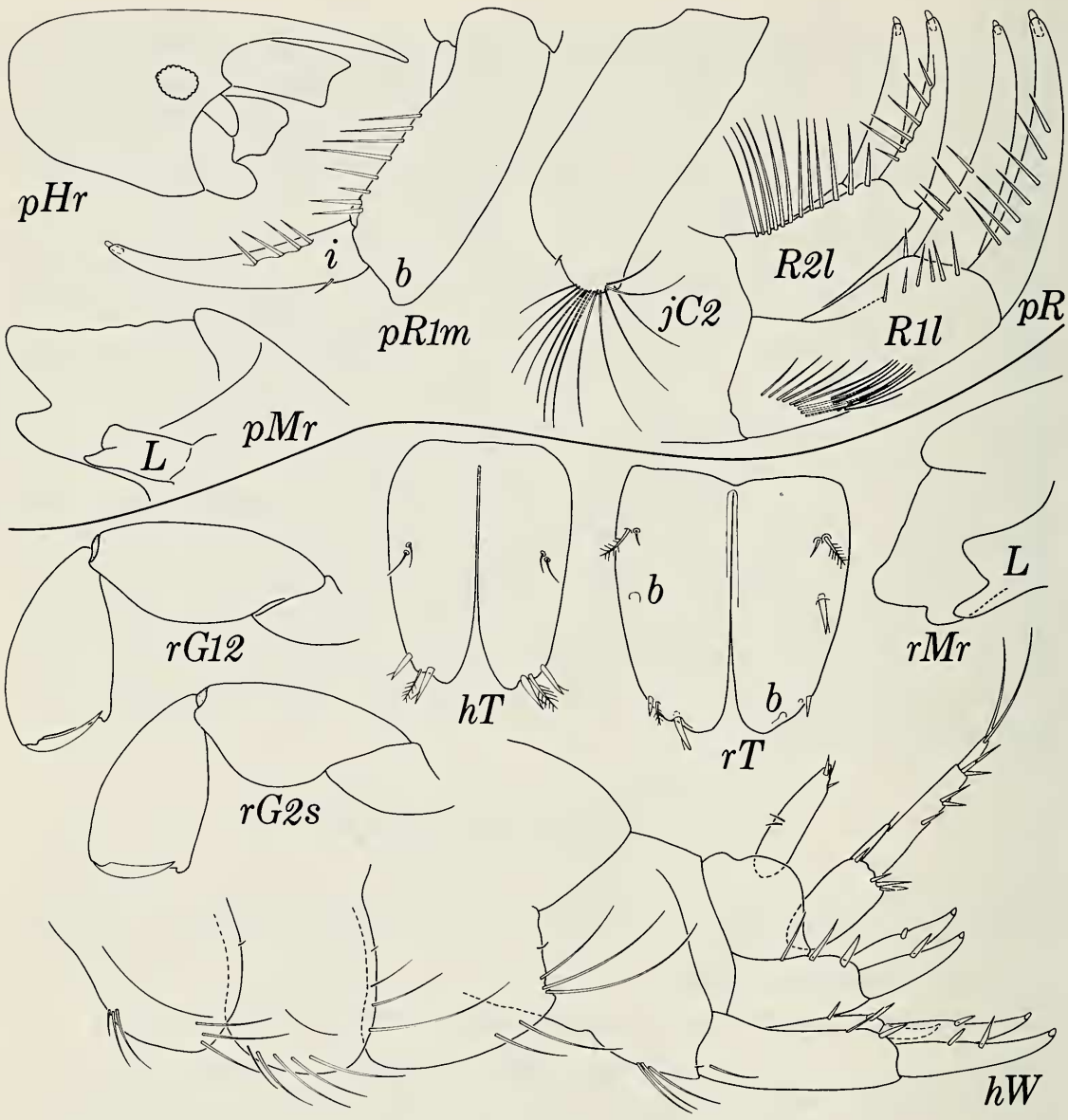

Fig. 2. UPPER, *Grandifoxus* sp. R: **j** = juvenile "j," **p** = female "p." Lower, *Grandifoxus longirostris*: **h** = juvenile "h;" r = female "r."

Capital letters refer to parts; lower case letters to left of capitals refer to specimens cited in "Voucher Material" for each taxon; lower case letters to right of capitals refer to adjectives cited below: **C,** coxa; **E,** epimera; **F,** epistome, lateral; **G,** gnathopod; **H,** head; **L,** lacinia mobilis; **M,** mandible; **N,** molar; **P,** pereopod; **R,** uropod; **T,** telson; **U,** upper lip; **W,** pleon. **b,** broken; **d,** dorsal; **i,** inner; **l,** left; **m,** medial; **o,** outer; **r,** right; **s,** setae.

about 21 percent of total body length, greatest width almost 80 percent of length, rostrum constricted, narrow, elongate, not reaching middle of article 2 on antenna 1. Eyes not apparent. Article 1 of peduncle on antenna 1 about 1.3 times as long as wide, about 1.9 times as wide as article 2, ventral margin

with about 5 setules, weakly produced dorsal apex with 2 setules, article 2 about 0.7 times as long as article 1, with midventral narrowly confined crescent of 7 setae, plus 3 apicolateral setae, primary flagellum with 6 articles, about 0.55 times as long as peduncle, bearing one short aesthetasc each on articles 3–5, accessory flagellum with 5 articles. Antenna 2 strongly ensiform, article 3 with 4 facial setae, spine formula of article 4 = 0-3-4-2, dorsal margin with 2 notches bearing 2 and 4 setae, ventral margin with 6 groups of 1–2 long to medium setae, one ventrodistal long spine, article 5 about 0.75 times as long as article 4, facial spine formula = 2, dorsal margin bearing one set of small setae, ventral margin with 5 sets of one long seta each, 3 ventrodistal long to medium spines set weakly facial; flagellum about 0.85 times as long as articles 4–5 of peduncle combined, with 6 articles.

Mandibles with weak palpar hump, right incisor with 3 teeth, left incisor with 3 humps in 2 branches, right lacinia mobilis scarcely bifid, moderately broad (damaged), left lacinia mobilis with 4 teeth, middle teeth not shortened, right and left rakers 8 plus one rudimentary, molars composed of short protrusions demarcated mainly by spines, right molar with 5 primarily medium spines plus one shorter and thick, serrate spine weakly disjunct, left molar with 7 primarily medium spines, no spine disjunct, each molar with plume, palp article 1 short, article 2 with one short inner apical seta and one other short basal inner seta, article 3 about as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 0-1 (marginal). Lower lip with one cone on each outer lobe. Inner plate of maxilla 1 ordinary, bearing one medium apical pluseta, one similar apicomedial seta, 2 slightly shorter apicolateral setae, palp article 2 with one apical spine, one apicolateral, 2 medial and 2 submarginal setae. Inner plate of maxilla 2 shorter than outer, outer much broader than inner, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 5 medial setae, outer plate with 6 medial and apical spines, one apicolateral seta, palp article 1 with one apicolateral seta, article 2 with 2 groups of 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 5 facial setae, 1–2 lateral setae, nail of article 4 short, moderately articulate, with unknown accessory setules (damaged).

Coxa 1 expanded apically, anterior margin weakly convex, main ventral setae of coxa 1–4 = 5-6-5-5, very narrowly constrained, posteriormost seta of coxae 1–3 slightly shortened, coxae 2–3 with weak ventral hump just anterior to setae, 1–2 setae of coxa 4 actually on posterior margin, anterior and posterior margins of coxa 4 almost parallel, posterior margin straight, posterodorsal corner rounded, posterodorsal margin short, V-shaped, undulate, width-length ratio of coxa 4 = 15:19. Gnathopods generally ordinary, width ratios on articles 5–6 of gnathopods 1–2 = 32:33 and 29:32,

length ratios = 66:52 and 66:52, palmar humps small, palms weakly oblique, article 5 of gnathopods 1–2 elongate, ovate, posterior margin rounded.

Pereopod 4 slightly thinner than pereopod 3 especially on article 5, facial setae formula on article 4 = 4 and 3 parallel to apex, on article 5 = 2 and 3, main spine of article 5 extending to M. 80 on article 6, article 5 with no proximoposterior spines, spine formula of article 6 = 5 + 5 and 5 + 6, plus no middistal seta or spine, some spines especially long, acclivity on inner margin of dactyls of pereopods 3–4 sharp, produced as tooth, emergent setule amost fully immersed, midfacial pluseta absent. Coxae 5–7 posteroventral seta formula = 5-6-4. Articles 4–5 of pereopods 5–6 broad, facial spine rows dense, facial ridge formulas of article 2 on pereopods 5–7 = 0-0-1!, width ratios of articles 2,4,5,6 of pereopod 5 = 57:50:43:19, of pereopod 6 = 80:49:40:17, of pereopod 7 = 89:25:24:11, length ratios of pereopod 5 = 85:47:45:34, of pereopod 6 = 93:62:50:61, of pereopod 7 = 99:26:28:28, article 2 of pereopod 7 reaching apex of article 4, posterior margin with 5 small serrations, medial apex of article 6 not combed, bearing 2–3 weak digital processes.

Posteroventral corner of epimeron 1 rounded, posterior margin convex, anteroventral margin with 3 short to medium setae, posteroventral face with 3 long setae in vertical row. Posteroventral corner of epimeron 2 rounded, posterior margin convex, with 3 widespread long setae, facial setae = 5. Posteroventral corner of epimeron 3 weakly protuberant, posterior margin undulant, short, with 3 setae at corner, ventral margin with 2 setae. Epimera 1–3 with setule on posterodorsal margin set in weak notch.

Urosomite 1 with lateral setule at base of uropod 1 plus midventral brushes, articulation line incomplete, urosomite 3 slightly protuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed apical nails, no accessory nails, outer ramus of uropod 1 with 2 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one dorsomedial spine, peduncle of uropod 1 with one basofacial seta and one apicolateral spine plus one seta, medially with 2 marginal spines plus enlarged displaced spine, peduncle of uropod 2 with 2 dorsal spines and one seta, medially with one small apical spine, apicolateral corners of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial setule, rami feminine, inner extending to M. 40 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.33, bearing 2 long setae, apicomedial margin of article 1 with one seta, lateral margin with 3 acclivities, spine formula = 1-2-2-2 or 1-2-2, setal formula = 0. Telson especially long, length-width ratio = 18:13, almost fully cleft, each apex of medium width, protuberant medially, lateral acclivity broad, shallow, with widely spread lateral and medial spines separated by setule, all elements medium, midlateral setules subequal, of medium size.

Description of female "r."—Head about 19 percent of total body length, greatest width about 90 percent of length, rostrum constricted, narrow, short, reaching middle of article 2 on antenna 1. Eyes medium, clear of pigment, ommatidia ordinary. Article 1 of peduncle on antenna 1 about 1.4 times as long as wide, about 1.9 times as wide as article 2, ventral margin with about 19 setules, weakly produced dorsal apex with 2 setules, article 2 about 0.8 times as long as article 1, with proximoventral crescent of 18 setae, primary flagellum with 9 articles, about 0.5 times as long as peduncle, bearing short aesthetasc each on articles 3–8, accessory flagellum with unknown (at least 6, broken) articles. Antenna 2 moderately ensiform, article 3 with 5 large and one small facial setae, spine formula of article 4 = 0-10-9, dorsal margin with 5 notches bearing 1–3 setae and 0–1 spine, ventral margin with 12 groups of 1–5 long to short setae, one ventrodistal spine of unknown length, article 5 about 0.75 times as long as article 4, facial spine formula = 4–2 or 0–7 (variable on each side), dorsal margin bearing 4 groups of small setae, ventral margin with 14 sets of 2 long to short setae, 3 ventrodistal long to short spines set subdistally; flagellum about 0.66 times as long as articles 4–5 of peduncle combined, with 10 articles.

Mandibles with weak palpar hump, right incisor with 3 teeth, left incisor with 3 humps in 2 branches, right lacinia mobilis bifid, distal branch little shorter than proximal, broad, proximal branch simple, pointed, left lacinia mobilis with 5 teeth, right rakers 14 plus one rudimentary, left rakers 13 plus one rudimentary, molars composed of short cones demarcated mainly by spines, right molar with 7 primarily long spines plus one shorter spine weakly disjunct, left molar with 6 primarily long spines plus one shorter spine weakly disjunct, each molar with plume, palp article 1 short, article 2 with one short inner apical seta and 2 other short inner setae, article 3 about as long as article 2, oblique apex with 11 spine-setae, basofacial formula = 0–4 all in one deep notch. Lower lip with one cone on each outer lobe. Inner plate of maxilla 1 ordinary, bearing one medium apicofacial pluseta, one similar medial seta, 2 apicolateral much shorter setae, palp article 2 with one apical spine, 3 medial spines, one apicolateral and 5 submarginal setae. Inner plate of maxilla 2 shorter than outer, outer broader than inner, outer with 5 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 4 apicofacial setae, 7 medial setae, outer plate with 6 medial and apical spines, 5 apicolateral setae, palp article 1 with one apicolateral seta, article 2 with 3 groups of 5 apicolateral setae, medial margin of article 2 strongly setose, article 3 with 9–10 facial setae scarcely strewn, 3 and 2 lateral setae, nail of article 4 short, moderately distinct, with one accessory setule.

Coxa 1 scarcely expanded apically, anterior margin weakly convex, main ventral setae of coxae 1–4 = 9-12-12-(11 ventral and 6 posterior), posteriormost seta of coxa 1 shortest, of coxae 2–3 scarcely shortened, coxae

2–3 with setose edge beveled, thus weakly similar to normal *longirostris* coxal form, anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin ordinary, almost straight, width-length ratio of coxa 4 = 8:9.

Gnathopods generally ordinary, width ratios on articles 5–6 of gnathopods 1–2 = 28:28 and 28:30, length ratios = 65:54 and 60:49, palmar humps ordinary, palms weakly oblique to almost transverse, article 5 of gnathopods 1–2 elongate, ovate, posterior margin flat.

Pereopod 4 stouter than pereopod 3, especially on articles 4–5, both very stout, facial setae formula on article 4 = 11 and 10, on article 5 = 9 and 9, main spine of article 5 extending to M. 80 on article 6, article 5 with no proximoposterior spines, spine formula of article 6 = 9 + 10 and 9 + 11 plus no middistal seta, some spines especially long, acclivity on inner margin of dactyls on pereopods 3–4 bluntly produced as tooth, emergent setule very short, midfacial pluseta ordinary. Coxae 5–7 posteroventral seta formula = 19-21-15 (some setae facial on coxa 6). Articles 4-5 of pereopods 5–6 broad to ordinary in width, facial spine rows moderately developed, facial ridge formula of article 2 on pereopods 5–7 = 0-1-1, width ratios of articles 2, 4, 5, 6 on pereopod 5 = 49:46:46:19, of pereopod 6 = 69:44:38:15, of pereopod 7 = 78:21:22:10, length ratios of pereopod 5 = 82:42:47:40, of pereopod 6 = 88:63:56:53, of pereopod 7 = 96:22:27:32, article 2 of pereopod 7 reaching middle of article 5!, posterior margin with 8–9 small serrations, medial apex of article 6 not combed, bearing 3–4 weak digital processes.

Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin weakly convex, serrate, setose (5), anteroventral margin and face with 7+ short to medium setae, posteroventral face with 4 scattered long setae, ventral margin with 11 setae, some in pairs. Posteroventral corner of epimeron 2 rounded-quadrate, posterior margin weakly convex, serrate, setose (10+), facial setae = 13 in ventral row and 5 scattered, posteriormost pair of ventrals set vertically. Posteroventral corner of epimeron 3 rounded-quadrate, posterior margin almost straight, serrate, setose (6), with one setule notch above, main setae confined mainly to ventral corner, ventral margin with 8 setae evenly spread.

Urosomite 1 without lateral or ventral setule at base of uropod 1, with ventral brush, articulation line incomplete, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with articulate, enlarged apical nails tightly fixed, including inner ramus of uropod 1, outer ramus of uropod 1 with 6 ordinary dorsal spines, inner with 3 larger, outer ramus of uropod 2 with 3–4 dorsal spines, inner with 2 dorsomedial spines, peduncle of uropod 1 with 4 apicolateral but slightly spread spines, medially with 5 marginal setae and spines, proximalmost thin, apicalmost enlarged, plus large displaced spine, peduncle of uropod 2 with 8 short dorsal spines, medially with one apical

spine same size as laterals, apicolateral corners of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 10 ventral spines, dorsally with one lateral spine, 3 medial setules, rami feminine, inner extending to M. 63 on article 1 of outer ramus, apex with 2 setae, medial margin setose, article 2 of outer ramus short, 0.11, bearing 2 medium or longer setae (as judged by size of snapped bases), medial margin of article 1 with 7 setae, lateral margin with 6 acclivities, spine formula = 1-2-2-2-2-2-2, setal formula = 0-0-0-0-0-1-1. Telson ordinary, length-width ratio = 35:31, almost fully cleft, each apex wide, rounded, lateral acclivities weak, with short lateral and longer medial spines separated by short setule, each side with dorsofacial spine near M. 45, midlateral setules diverse, larger of medium size.

Remarks.—This juvenile identified by the describer of the species fits the original description adequately; the important character of displaced medial spine on the peduncle of uropod 1 is the critical feature separating the species from *G. grandis*; other characters such as the strange *grandis* (*milleri*) coxae might not be well developed in juveniles just as they are poorly developed in this juvenile. The giant specimen from Kyska differs from the juvenile in the enlarged and bifid right lacinia mobilis, the even more poorly developed humps on the coxae and the much stronger but expected armaments almost everywhere. The elongate article 2 on the outer ramus of uropod 3 in the juvenile is a normal feature of juvenile phoxocephalids.

Besides the displaced spine on uropod 1, the narrow spread of ventral setae on coxa 1 seems to be a good specific character of *longirostris*. Gurjanova's (1938:figs. 7–10) illustration of telson shows one apical and one lateral spine whereas juvenile "h" here has apical and no lateral spines. However, the giant female "r" from Kyska has the appropriate dorsolateral spine shown by Gurjanova. The large adult lacks facial setae on urosomite 1, unlike *grandis*.

Material.—Juvenile "h" 3.15 mm, Japan Sea near the Petrov I., 1/10/1934, det. E. Gurjanova; female "r" 10.4 mm, Kyska Harbor, Alaska, USA, sand 6–8 fms, W. H. Dall 165 (1002), U.S. Coast Survey Prof. B. Peirce, Supt.

Distribution.—Japan Sea into the Bering Sea and eastward to Kyska Island, Alaska, 10–15 m; if *lindbergi* is added, depth range possibly extending downward to 75 m.

Grandifoxus sp. R
Fig. 2, upper

Nomenclature.—This species may be *robustus* Gurjanova or *r. lindbergi* Gurjanova but until they are redescribed they must remain dubious. See center cuts of these species later.

Description of female "p."—Head about 20 percent of total body length, greatest width about 72 percent of length, rostrum weakly constricted, tapering almost evenly to narrow apex, exceeding middle of article 2 on antenna 1. Eyes small, clear of pigment, ommatidia especially small. Article 1 of peduncle on antenna 1 about 1.6 times as long as wide, about 2.1 times as wide as article 2, ventral margin with about 16 setules, weakly produced dorsal apex with 3 setules, article 2 about 0.7 times as long as article 1, with widely spread midventral cycle of 28 setae, primary flagellum with 11 articles, about 0.5 times as long as peduncle, bearing one short aesthetasc each on articles 5–10, accessory flagellum with 10 articles. Antenna 2 ensiform, article 3 with 11+ setae; spine formula of article 4 = 0-16-18, linearly aligned, dorsal margin with 5 notches bearing 1–4 setae, ventral margin with 18 groups of 1–5 long setae, one ventrodistal long spine, article 5 almost 0.8 times as long as article 4, facial spine formula = 8-7-4, linearly aligned, dorsal margin bearing 3 groups of small setae, ventral margin with 18 sets of 1–2 long to medium setae, 3 ventrodistal long to short spines set slightly facial; flagellum about 0.7 times as long as articles 4–5 of peduncle combined, with 15 articles.

Mandibles with weak palpar hump, right incisor with 3 teeth, left incisor with 3 humps in 2 branches, right lacinia mobilis scarcely bifid, moderately broad, left lacinia mobilis with 4 teeth, middle teeth not shortened, right and left rakers 13 plus 1–2 rudimentaries, molars composed of medium bulbous protrusions each with 11 primarily medium spines plus one short thick and serrate spine weakly disjunct, each molar with plume; palp article 1 short, article 2 with 4 medium inner apical setae and 1–2 other shorter inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 17 spine-setae, basofacial formula = 4-2 plus 4–5 setae in marginal notch more distad. Each outer lobe of lower lip with one cone. Inner plate of maxilla 1 especially large, broad, bearing one long apical pluseta, one shorter but similar apicomedial seta, 3 apicolateral much shorter setae, palp article 2 with one apical and 3 medial spines, one apicolateral and 6 submarginal setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 10 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large thick apical spines, 4 apicofacial setae, 5 medial setae, outer plate with 9 medial spines, 8 apical and lateral setae, palp article 1 with 3 apicolateral setae in 2 groups, article 2 with 5 groups of 9 lateral setae, medial margin of article 2 strongly setose, article 3 with 16 slightly strewn facial setae, 5 lateral setae in 2 groups, nail of article 4 short, moderately articulate, with 2 accessory setules.

Coxa 1 not expanded apically, anterior margin weakly convex, main ventral setae of coxae 1–4 = 25-17-16-15 (and 36 posterior setae on coxa 4), posteriormost seta of coxae [broken, coxae 1–3 with ventral hump at anterior limit of setae, setae not widely spread on coxa 1, anterior and pos-

terior margins of coxa 4 slightly divergent, posterior margin almost straight, posterodorsal corner sharp, posterodorsal margin short, concave, width length ratio = 3:4. Gnathopods generally ordinary, width ratios on articles 5–6 of gnathopods 1–2 = 27:27 and 25:28, length ratios = 65:52 and 65:52, palmar humps small, palms almost transverse, article 5 of gnathopods 1–2 elongate, oval, posterior margin flat, long.

Pereopod 4 stouter than 3, especially on articles 4–5, facial setae formula on article 4 = 13 and 12, almost parallel to apex, on article 5 = 13 and 14, main spine of article 5 extending to M. 90 on article 6, article 5 without proximoposterior spines, spine formula of article 6 = 10 + 11 and 11 + 12, plus no middistal seta, some spines especially long, acclivity on inner margin of dactyls of pereopods 3–4 sharp, produced as tooth, emergent setule amost fully immersed, midfacial pluseta ordinary. Coxae 5–7 posteroventral seta formula = 27+-35(2 rows)-20.

Articles 4–5 of pereopods 5–7 broad to ordinary in width, facial spine rows dense, facial ridge formula of article 2 = 0-1-1, width ratios of articles 2,4,5,6 of pereopod 5 = 60:60:48:19, of pereopod 6 = 94:62:49:19, of pereopod 7 = 101:24:27:12, length ratios of pereopod 5 = 105:50:50:39, of pereopod 6 = 105:65:66:72, of pereopod 7 = 106:28:32:44, article 2 of pereopod 7 almost reaching apex of article 4, posterior margin with 10 small to medium serrations, posteroventral margin either beveled or slightly oblique (not fully horizontal), medial apex of article 6 not combed, bearing 6–7 large digital processes.

Posteroventral corner of epimeron 1 rounded, posterior margin convex, serrate, setose (13), anteroventral margin and face with 20 long to short setae, ventral face with 3–4 pairs of long setae, plus 4 setae on or near lateral ridge. Posteroventral corner of epimeron 2 rounded, posterior margin convex, serratosinose, setose (17), anterior margin with cluster of 16 setae, facial setae = 27 strewn + 2 on lateral ridge, many pairs, triads and quartets set vertically. Posteroventral corner of epimeron 3 rounded, posterior margin almost straight, serratosinose, setose (6) + 4 setule notches, ventral margin with 20 setae, almost evenly spread and occasionally in vertical pairs or triads, face with 8 strewn setae, anterior margin with 11 setae in tandem.

Urosomite 1 with lateral setule at base of uropod 1 and 13 lateral setae and setal spines forming row but some setae in pairs, plus ventral brush, articulation line almost complete, urosomite 3 weakly protuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed apical nails, outer ramus of uropod 1 with 7 dorsal spines, inner with 4, outer ramus of uropod 2 with 6 dorsal spines, inner with none, peduncle of uropod 1 with 2 rows of 9 and 5 basofacial setae and 6 small apicolateral spines, medially with 8 marginal setal spines, apicalmost thin and scarcely displaced, peduncle of uropod 2 with 12 dorsal spines and setae, medially with 4 short spines spread halfway along margin, apicolateral corners of peduncles on uropods 1–2

without comb. Peduncle of uropod 3 with 15 ventral spines, dorsally with one lateral spine and one setule, one medial seta and 2 setules, rami feminine, inner extending to M. 65 on article 1 of outer ramus, apex with one seta, apicomedial margin with one seta, article 2 of outer ramus short, 0.06, bearing 2 setae [broken], medial margin of article 1 with 6 setae, lateral margin with 5 acclivities, spine formula = 1-3-3-3-3-3, spines short, setal formula = 0. Telson ordinary, length-width ratio = 8:7, almost fully cleft, each apex wide, rounded, with 1–2 narrow and weak lateral acclivities, spination variable on same specimen, either bearing 2 short lateral spines with medial similar setule or with short lateral and medial spines separated by similar setule, dorsolateral surface at M. 45 with 4 spines on each side, lateral setules at M. 30, diverse, larger of small size.

Juvenile "j."—Article 2 of antenna 1 with 20 setae in ventral crescent, primary flagellum with 9 articles, accessory with 7. Antenna 2 strongly ensiform, article 3 with 5 facial setae, spine count on article 4 = 0-10-7, on article 5 = 4-4. Article 5 of pereopod 7 as broad as in adult and *G. grandis*. Setae of epimeron 1, facial on ridge = 5, on posterior face = 4 strewn, posterior = 7; on epimeron 2 facial = 10, 3 of these posteriorly in vertical row ridge with 3, posterior with 10 strewn; on epimeron 3 ventral = 2 anterior and 7 posterior separated by large gap, posterior = 6 but dorsals spilling onto face, plus 2 posterior setules. Urosomite 1 with 5 facial setae. Armaments of uropod 1, basofacial peduncle = 3, apicolateral = 3 spines, medial = 4, none displaced, outer ramus with 5, inner with 2, all spines long as in adult; uropod 2 peduncle dorsolateral = 5 long (at least basal), outer ramus with 3, inner with 0; uropod 3 peduncle = 8 ventral spines, outer ramus lateral spine groups = 1-2-2-2, article 2 very short. Telson more elongate than in 16 mm adult, each apex with 2 medium spines separated by setule, dorsolateral spine present on each side.

Remarks.—Some adult specimens with 3 apical spines plus setule on each lobe of telson.

Posterior setae on epimera 1–2 usually strewn, or almost organized into 2 rows, or spilling onto face. Strong curve on rami of uropod 1 typical of all specimens.

Large specimens in poor condition, mushy, full illustrations to be reserved until better materials becoming available.

Relationship.—Differing from *G. grandis* in lack of spine on inner ramus of uropod 2; possibly this species and *grandis* form a pair of congruent subspecies. However, the setation of epimeron 3, even in juveniles, is much more widely scattered and more numerous in species R and this adds a second, albeit weak, difference between the two taxa.

Voucher material.—Female "p" 16.8 mm, Chirikoff Island, Alaska, Anchorage, 9–14 fms, sand, 1874, W. H. Dall; juvenile "j" 8.65 mm, Ins. Bering, USNM 13662, Accession No. 16878, 1884, N. Grebnitzky.

Other material.—Same Grebnitzky sample as above, 5 more specimens; another similar sample, USNM 13669, Accession No. 16878, 1884, N. Grebnitzky (1); St. Paul Id., Alaska, 6–9 fms, sand, 2 July 1874, W. H. Dall (1163) (1); Semidi Ids., Alaska, 12–18 fms, gravel, 1874, W. H. Dall (1152) (1); Alaska, 60-16 N, 167-41 W, 7 January 1884, Tag 25, [?Accession] No. 15688, Lieut. George M. Strong, U.S.N. (2); off Point Moller, Alaska, Bering Sea, 6 May 1941, King Crab Investigations C-108, Accession No. 161385 (1).

Distribution.—Japan Sea to western Alaska and into the Bering Sea, 8–16 m.

Grandifoxus sp. 51
Fig. 1, lower right

These specimens, like *Grandifoxus* sp. J, are characterized by jeweled spines on uropods 1–2 but resemble *Grandifoxus* sp. R in the absence of the spine on the inner ramus of uropod 2. On the other hand, they resemble *G. longirostris* in the presence of only pairs (not triads) of spines on uropod 3. This taxon is intermediate between *longirostris* and *grandis*-sp. R in the presence of short and poorly developed setae on the lateral face of urosomite 1; setae are absent in *longirostris* but well developed in *grandis*-sp. R. Unlike other taxa of *Grandifoxus* the coxal humps are almost undetectible.

Material.—Female "a" 14.9 mm (not of senile appearance) and female "g" 9.7 mm, Chichagoff Harbor, Attu, Alaska, 5–7 fms, gravel, sand, 1873, W. H. Dall (985).

Grandifoxus robustus (Gurjanova), revived

Pontharpinia robusta Gurjanova, 1938:262–263, 385, figs. 6, 6a; 1951:384–385, figs. 233, 234.
Pontharpinia robusta lindbergi Gurjanova, 1953:224–225, figs. 7, 8.
Paraphoxus milleri lindbergi.—J. L. Barnard, 1960:269.

Nomenclature.—This taxon was synonymized with *G. milleri* by J. L. Barnard (1960) and was also a homonym at that time. Modern practice allows removal from homonymy because the senior homonym is now distinct generically.

Now that species R, described above, is recognized as a species distinct from *longirostris* and *grandis* (=*milleri*) there is a possibility that the correct name for R must be either *robustus* (Gurjanova) or *lindbergi* (Gurjanova). Until they are redescribed the names cannot be assigned to any of my material.

Acknowledgments

I thank Irene F. Jewett, who inked my drawings, and Elizabeth B. Harrison and Janice M. Clark, who assisted me in the laboratory.

Literature Cited

Barnard, J. L. 1958. Revisionary notes on the Phoxocephalidae (Amphipoda), with a key to the genera.—Pacific Science 12:146–151.

———. 1960. The amphipod family Phoxocephalidae in the eastern Pacific Ocean, with analyses of other species and notes for a revision of the family.—Allan Hancock Pacific Expeditions 18:175–368, pls. 1–75.

———. 1979. Revision of American species of the marine amphipod genus *Paraphoxus* (Gammaridea: Phoxocephalidae).—Proceedings of the Biological Society of Washington 92:368–379.

———, and M. M. Drummond. 1976. Clarification of five genera of Phoxocephalidae (marine Amphipoda).—Proceedings of the Biological Society of Washington 88:515–547, figs. 1–4.

———, and ———. 1978. Gammaridean Amphipoda of Australia, part 3. The Phoxocephalidae.—Smithsonian Contributions to Zoology 245:1–551, pls. 1–269.

Gurjanova, E. 1936. Neue Beiträge zur Fauna der Crustacea-Malacostraca des arktischen Gebietes.—Zoologischer Anzeiger 113:245–255, figs. 1–5.

———. 1938. Amphipoda, Gammaroidea of Siaukhu Bay and Sudzuhke Bay (Japan Sea).—Reports of the Japan Sea Hydrobiological Expedition of the Zoological Institute of the Academy of Sciences, USSR, in 1934, 1:241–404, figs. 1–59 (in Russian with English title and summary).

———. 1951. Bokoplavy morei SSSR i sopredel'nyx vod (Amphipoda-Gammaridea).—Opredeliteli po Faune SSSR 41:1–1031, figs. 1–705.

———. 1953. Novye dopolnenija k dal'nevostochnoi faune morskik bokoplavov.—Trudy Zoologicheskie Instituta 13:216–241, figs. 1–19.

Schellenberg, A. 1931. Gammariden und Caprelliden des Magellangebietes, Südgeorgiens und der Westantarktis.—Further Zoological Results of the Swedish Antarctic Expedition 1901–1903 2:(6)1–90, 1 pl., 136 figs.

Stimpson, W. 1856. On some Californian Crustacea.—Proceedings of the California Academy of Science 1:87–90.

———. 1857. The Crustacea and Echinodermata of the Pacific shores of North America.—Journal of the Boston Society of Natural History 6:444–532, pls. 18–23.

Thorsteinson, E. D. 1941. New or noteworthy amphipods from the North Pacific coast.—University of Washington Publications in Oceanography 4:50–96, pls. 1–8.

Department of Invertebrate Zoology, Smithsonian Institution, Washington, D.C., 20560, USA.